Volume 18 October, 1932 *Number 10*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Petroleum Products in the Textile Industry

Chemical Aspects and Oil Stain Elimination

PUBLISHED BY
THE TEXAS COMPANY
TEXACO PETROLEUM PRODUCTS

II

THE ANTI-FRICTION BEARING HAS A

Double Duty

TO PERFORM IN THE TEXTILE INDUSTRY

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Published by
The Texas Company, 135 East 42nd Street, New York City
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Vol. XVIII October, 1932 No. 10

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Petroleum Products in the Textile Industry

Chemical Aspects and Oil Stain Elimination

TEXTILE materials are of animal or vegetable origin. So are lubricants. This thought must not be dismissed too casually in consideration of textile machinery lubrication, in view of the potential reactions which may occur between certain of their chemical components should they come in contact.

Such reactions may be decidedly serious, not from the viewpoint of causing actual change in texture or form, as would occur through chemical reaction between organic elements, but rather due to the effect on the finished product.

It is fitting, therefore, to discuss those operations in the manufacture of textile products, where such reactions may occur due to contact of lubricants or where fixed or fatty oil compounds are essential in the preliminary treatment of the raw materials, such as silk or wool. To enable a more complete understanding of the problem, the meaning and significance of certain tests which have been adopted by the petroleum industry for the determination of the chemical quality of lubricants have been briefly studied. Every effort has been made to refrain from dealing with the more intricate details of pure chemistry, with the thought that the operation of textile machinery is a strictly mechanical engineering feature.

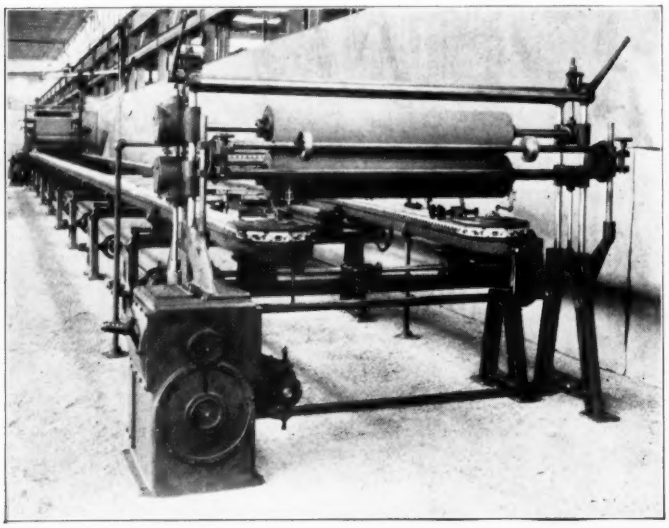
The textile industry is unique in that mineral oils (particularly in compound with animal or vegetable oils) can be used for a variety of purposes other than actual machine lubrication. Outstanding examples of this involve:

Raw Stock Oils—used in actual fibre lubrication of wool, rayon and cotton products prior to spinning. Application of stock oils and the percentage necessary will depend upon the nature of the stock to be treated. Originally wool was treated with animal or vegetable oils almost entirely, using products such as lard oil, olive or peanut oil or degras. It is practicable to compound certain of the above products with a mineral oil component. In this way the possibility of rancidity and objectionable odors will be reduced. At the same time the compounded oil will possess sufficient ability to readily form and maintain a persistent emulsion which can be washed out prior to spinning.

In the treating of cotton stock mineral oils have indicated a similar suitability. Less oil is required, however, for cotton than for wool.

The process of oiling raw stock textile products must be a distinctly physical operation, based on the emulsifying ability of the oil used. Any tendency toward chemical reaction might be objectionable due to the possibility of spontaneous combustion. Separation of the subsequent emulsion to leave

any trace of free mineral oil in the stock after washing, would also be objectionable for it might affect the "take" of certain dyes in latter dyeing processes.



Courtesy of Morrison Machine Company

Fig. 1—Showing the entering end of a Sanforizing machine. Entire construction of this machine has been carried out with a view to preventing oil spots or damaged goods in any stage of treatment.

Softening or Finishing Oils—in turn are used where it is desirable for a certain amount of oil to be retained by the goods in order to improve the feel. Softening oils are used during the finishing stages. The use of mineral oils in compound with certain fixed or fatty products has been found advantageous in the interest of reducing the tendency toward rancidity and objectionable odor. It is important to use a non-oxidizing oil for this reason, for the development of any chemical reaction of this nature might defeat the purpose for which the oil is used.

The use of a softening oil is practiced in the silk industry prior to "throwing."

Soaking—is a process to which raw silk is subjected before it is "thrown" or spun into yarn, in order to soften and slacken the gums and reel markings and render the thread pliable and ductile. For this purpose a mixture of oil, soap, borax and warm water is used. The oils generally employed in this process are olive, neatsfoot, lard or a compounded mineral oil; their purpose is to serve as a lubricant for the thread and to soften the action of the soapy mixture on the silk. Otherwise, the threads would dry stiff, hard, and relatively sticky. This oil is later boiled out prior to the dyeing process. The essential point is to use an oil that will not leave any odor, and will have sufficient viscosity to form a dependable film over the silk. According to authorities a satisfactory mineral oil compound for this purpose can be prepared, consisting of a mineral oil of approximately 200 seconds Saybolt viscosity at 100 degrees Fahr., and 70 per cent neatsfoot oil.

Knitting Oils—as used in the lubrication of yarns prior to knitting, may also be compounds of mineral products. One of the important problems in the use of knitting oils is to prevent rust or corrosion of needles. In this connection use of an oil capable of developing a permanent and substantial emulsion is of distinct advantage.

EMULSIFICATION

By reason of the importance of emulsification in connection with oils of mineral-compound nature, used in textile operations, thorough understanding of its significance is necessary.

Emulsification is a factor in consideration of textile oils wherever contact with the yarn or fabric is necessary or may develop in the course of treatment. In service of this nature oils which separate relatively slowly from water have been proved most readily washed out in the subsequent finishing operations. This is a matter of distinct importance in the interest of preventing permanent oil stains.

Formation of Emulsions

Positive emulsification can be developed by compounding with a fixed oil. What actually occurs in operation can be best understood by shaking a well-refined mineral oil with water in a bottle, then allowing it to stand and settle for a few seconds. It will be noted that the respective liquids will separate, with a sharp surface of demarcation and that each will be comparatively clear. If, however, certain fixed oils or soaps are added to the mineral oil and the subsequent compound similarly agitated with water the two liquids will separate slower, or they may remain fixed for an indefinite period. The more intimate the mixture, the better and more lasting will be the emulsion.

It is explained by the fact that where there is intimate mixture of two liquids which are insoluble or only slightly soluble in each other, the mixture becomes so stable and the liquids so mutually held in suspension that separation due to differences in specific gravity or density is very slow. This covers the usual conception of emulsification in the oil industry and as it should be understood by the textile man.

In view of the fact that there are practically no limiting conditions which will definitely determine whether there is a complete emulsion as the transition from a solution to an emulsion is not sharp, it must be realized that in some cases an emulsion may exist and yet the resultant combination of certain oils plus water may appear to be a true solution due to the clearness.

Emulsification in its development is essentially a physical phenomenon, as it is brought about between mineral oil plus a fatty component and water. Where oil spots are to be removed from a textile fabric in any washing or finishing process by use of an aqueous alkaline solution, subsequent development of saponification becomes a chemical reaction. The completeness of this reaction will be indicative of the extent to which oil spots can be removed. Inasmuch as this depends upon the initial degree of refinement of the lubricating oil and the purity of its fatty oil component, it is obvious that the emulsifying ability of the product should be carefully studied.

Theory of Emulsification

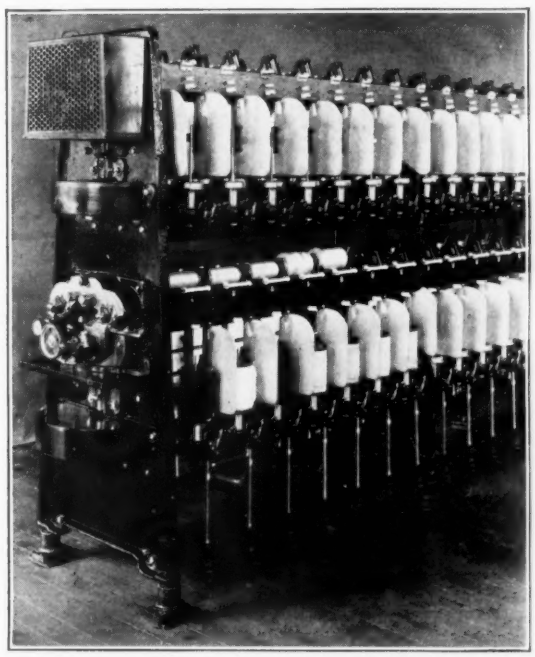
Although there are many features pertinent to emulsification which have not as yet been satisfactorily and completely explained according to the usually accepted theories of physical and chemical science, great progress on the other hand has been made, and sufficient experimental data has been accumulated to allow prediction of results with a fair degree of accuracy. The most generally accepted theory is that there is a balancing of physical and perhaps chemical forces at the surfaces between water and oil, so that there is no resulting tendency for the individual drops to either combine or become further subdivided.

With oils which lend themselves to ready emulsification, the prevailing forces are of sufficient intensity to prevent or at least so retard the action of gravity towards separation of liquids of different density, that they will remain in more or less permanent emulsion. There are some liquids, such as soluble oil, which will emulsify with greater rapidity, the particles reaching their final balanced state of subdivision very quickly. Others must be mechanically or otherwise atomized, before they remain permanent in suspension with respect to water.

Laboratory examinations of certain types of emulsions indicate that the particles are so small that they can only be observed under an ultra-microscope. When thus seen they are found to be in constant rapid motion, the smaller particles being most active. Physicists call this the Brownian movement. In some cases the particles are so fine that they cannot even be seen by the ultra-microscope and are only believed to exist by reason of the fact that a beam of light is scattered through a solution or liquid combination wherein they are contained. This scattering of a light beam, called the Tyndal effect, is generally taken as indicating the dividing line between a true molecular solution and an emulsion, or colloidal solution.

Emulsibility, or the ability of an oil to emulsify, is determined in the laboratory by agitation with water, and then noting the readiness with which separation of the resultant oil-water emulsion will occur. The object, of course, is to study the emulsifying tendency of the oil. There is, a distinct relation between emulsification, or the rate at which an emulsion will develop when an oil is agitated with water, and demulsibility, or the rate at which this emulsion will separate into its original components.

Wherever oil staining may occur, with subsequent necessity for washing of any type of textile material, the emulsibility as well as the subsequent demulsibility of any proposed lubricant must be given the most careful attention, not only when making initial selection and purchase of the product, but also in its subsequent usage.



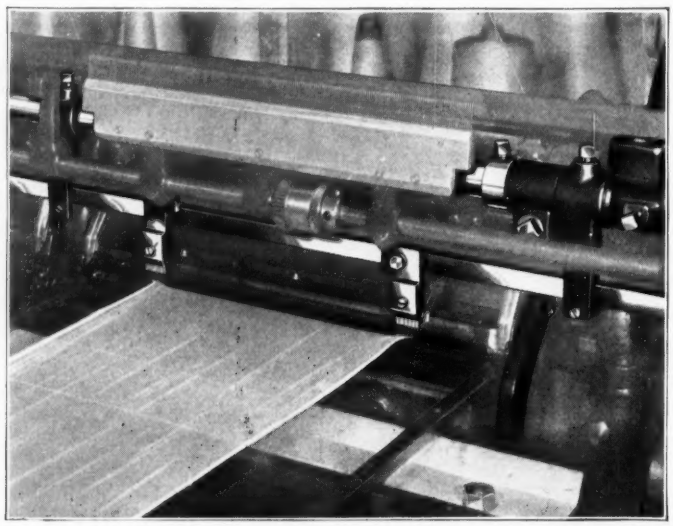
Courtesy of U. S. Textile Machine Company, Inc.

Fig. 2—View of a rayon machine, used in the twisting of loose filaments. Extreme care in lubrication is essential, in order to protect the product being handled.

SAPONIFICATION

Saponification is a factor in the production of oil-free textile fabrics by reason of its relation to effective washing. As its name implies, it is a chemical reaction having to do with the

production of soaps by treatment of a fatty oil with certain types of alkaline solutions. In order for saponification to be most effective where textiles are involved, the soaps should be water-soluble. This will enable most complete removal of any oil or grease spots during washing or bleaching operations. Where dealing with oil spots both emulsification and subsequently saponification are essential; the more complete the former the more thoroughly can saponification be brought about, with satisfactory removal of oily particles from the goods.



Courtesy of Textile Machine Works

Fig. 3—View of the narrowing motion of a full fashioned knitting machine. Note proximity of fabric to operating mechanisms.

Removal of grease spots, however, should be a more simple matter, for due to the fact that saponification has already been accomplished, all that is necessary is to dissolve the existing soap. It is therefore important in the selection of greases for textile mill operators to investigate the nature of the soap content as to its solubility in water.

In studying the relation of saponification to textile machinery lubrication it is well to remember that one of the essential differences between fixed or fatty oils and mineral oils involves the ability or susceptibility of the former to undergo a simple chemical reaction whereby the original compounds are split up and their elements recombined chemically, generally with certain of the alkali group. Combinations of the larger portion of the fatty oil molecules with a metal in this manner are termed soaps, the reaction being known as saponification. The more common soaps are produced by treatment of a fatty oil with caustic soda or potash. On the other hand, in the preparation of certain types of lubricants, it is also practicable to employ soaps containing lime (calcium), aluminum or lead.

Although saponification is a characteristic which is normally foreign to petroleum or mineral oils, it should be understood that, dependent upon the source of these latter, there may be a very slight tendency toward this phenomenon. In general, however, soaps are produced directly from fixed oils or fats. On the other hand, the chemistry of petroleum has indicated that the same result may be obtained by the action of an alkali upon a fatty acid. The term saponification, therefore, may also be applied to the action of an alkali upon those acids of an organic nature which may be produced in a slight degree in straight petroleum oils.

Determination of Saponifying Ability

This property of fatty oils to produce soaps has been used to advantage in the development of means for determining the presence of such an oil and its approximate volume in a mixture of mineral and fatty oils. The test is commonly known as the determination of the saponification number. Most fixed or fatty oils will react with caustic soda or potash to approximately the same degree. In other words, the equivalent amounts of the former will neutralize the alkalinity of about the same amount of caustic. In order to express this effect in a comparative manner the unit has been taken as the number of milligrams of caustic potash that will react with or be neutralized by one gram of oil. This is called its saponification number.

For most fixed or fatty oils the saponification number will range between 190 and 200. As a result, where an unknown product or lubricant is involved, by determining its saponification number a fair approximation can be made as to the amount of fatty oil contained. If the nature of this fatty oil is indicated by other tests the percentage can be determined more exactly, inasmuch as the saponification numbers of the various pure fixed oils employed by the petroleum industry are definitely known. In the opinion of certain authorities the saponification number is of real value as an indicator of the suitability of a lubricant for textile service.

ACIDITY AS DETERMINED BY NEUTRALIZATION

In studying the potential acid characteristics of lubricants for service where corrosion may be a factor, as for example knitting machinery and needle mechanisms, the acidity must be considered particularly where compounded oils are used.

The A.S.T.M. advances some highly pertinent thoughts, in discussing acidity, under the subject 'Neutralization,' viz.:*"Practically all petroleum lubricating oils contain substances of varied and indeterminate chemical composition which have acid characteristics. The proportion of these substances present in an oil is commonly referred to as its 'organic acidity'. These acid compounds are, mainly, natural constituents of crude petroleum and their presence in finished lubricating oil is not necessarily an indication of improper refining or poor quality."

"A large proportion of the petroleum lubricating oils now produced undergo treatment with mineral acid and caustic alkali in the course of refining. If the refining operations are not properly conducted, small quantities of one or the other of these chemicals may remain in the finished oil and, of course, are undesirable and unnecessary impurities."

"The 'Neutralization Number' of an oil is defined as the weight in milligrams of potassium hydroxide required to neutralize one gram of oil. It represents the sum of the quantities of mineral and so-called organic acids present in the oil or the difference between the organic acidity and the alkali present in the oil. If, as is usually the case, no mineral acid or alkali is present in the oil, the neutralization number is directly proportional to 'organic acidity.'

Significance of Results

"It is obvious that the effect of alkali or mineral acid in a petroleum oil is deleterious, and it is usual to specify that the Alkali or Mineral Acid Neutralization Number shall be either zero or some extremely low figure. The practical significance of 'organic acidity' is complicated by many considerations. The essential facts are as follows:

1. Oils derived from certain crude oils commonly show low neutralization numbers while oils from other crude oils show relatively high neutralization numbers unless subjected to special processes.
2. The organic acids normally present in lubricating oils are not corrosive and have no directly harmful effects.
3. It is contended by some, although the supporting evidence is not absolutely definite, that the presence of organic acids improves the friction-reducing qualities of oil."

* The significance of Tests of Petroleum Products—Report of Committee D-2 of the A.S.T.M., July, 1929—P. 42-43.

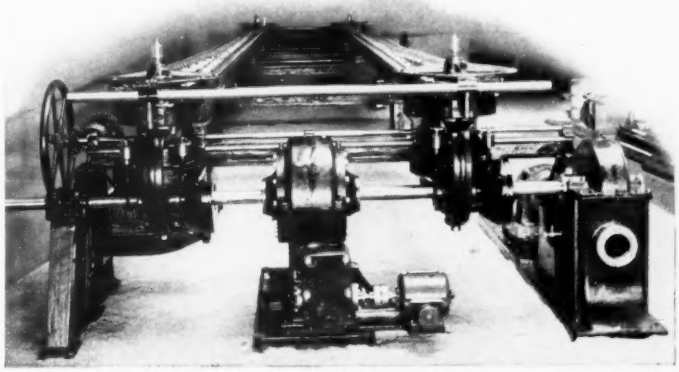
The relation which acidity bears to emulsification and sludge formation has been the basis of considerable study on account of the extreme complexity of the acid-forming constituents such as sulfur and oxygen, and the limited knowledge of their reactional tendencies. Were these reactions known more positively, or could oils be so refined as to remove or more effectively neutralize their detrimental acid-forming constituents, the problem of corrosion might be materially simplified.

As it is, effort can only be made in refinement to render oils as chemically stable as possible. The most careful attention to the oils throughout the process of refining should always be observed. But no process renders an oil non-reactive when it is subjected to detrimental conditions in the presence of air and water under high temperatures.

RESISTANCE TO OXIDATION

Among the several factors which may influence the durability of a highly refined textile oil, oxidation is regarded as requiring careful consideration. Mineral oils will be subjected to more or less oxidation when subjected to contact with water, especially under higher temperatures in the presence of air. These conditions are normally so involved and so contingent upon one another, however, that no one of them can be rightly claimed as being more detrimental than the other. On the whole, however, it may be stated that the extent to which an oil will resist oxidation depends largely upon the refinement of the original oil. In other words, certain petroleum hydrocarbons will probably oxidize more readily than others.

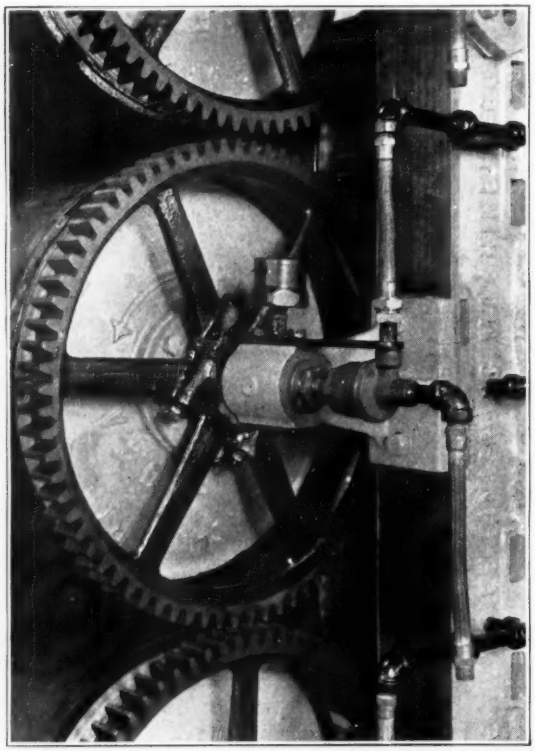
It is therefore advisable to bend every effort in the refinery to effect the removal of these components by careful and accurate refining



Courtesy of Winsor and Jerauld Manufacturing Co., Inc.

Fig. 4—End view of a straight tenter. This machine is provided for automatic lubrication throughout. All gear cases and other elements are housed to prevent leakage or throwing of oil onto the goods being handled. Such construction insures protection of moving elements and economy in lubricant consumption.

The more reliable the manufacturer, naturally the more dependence can be placed on his methods of refining. Oxidation will, of course, occur in practically any oil if it is subjected to



Courtesy of The Textile-Finishing Machinery Company

Fig. 5—Showing a close up view of bearing and oil cup on an upright type of drier. Note proximity of gear teeth to drier drums. Bearing protection is insured by using principles of wick feed lubrication within the oil cup.

oxidizing conditions. In fact, wherever particles of air and water are suspended or retained within the body of an oil to form an emulsion, only a slight elevation of temperature during operation will be necessary to bring about an oxidizing reaction between the air and oil.

As an adjunct to emulsification, oxidation may be said to have certain advantages. As the forerunner of sludge formation and development of acidity, it is a detriment rather than an advantage.

OILING OF WOOL

In the manufacture of wool products petroleum oils serve a dual purpose in that not only are they the basic components of all machine lubricants, but they can also be used in connection with the oiling or conditioning of stock in order to soften the de-greased fibres and facilitate carding and combing.

The fact that the essential purpose of the reconditioning of stock is to soften the fibres so that they will slip more readily in the processes of picking, carding and combing, gives ample justification for denoting this as fibre lubrication.

As a general rule it will be carried out in one or more stages of the process of preparing the wool fibres for spinning. Wool stock whether it comprises the raw product or shoddy, such as the wool fibres of rags, is all naturally degreased to a large extent, this having been brought about during the original processing or scouring of the product. As a result the wool fibres must be artificially oiled at this stage. For this purpose a saponifiable oil which can be subsequently removed by scouring, etc., prior to dyeing, will, in general, give the best results.

Another use that is made of wool oils is in the process of gilling where the fibres are often treated or oiled with pure fixed oils such as olive or lard, or with emulsions made from such products in compound with mineral oils and water. The essential advantage of emulsions is their relatively low cost as compared with straight fixed, animal or vegetable oils. In the spinning of worsteds oiling is claimed to not only improve the uniformity of the yarn, but also reduce the amount of fly.

Essential Characteristics

The essential characteristics which a wool oil should indicate are:

1—A low percentage of fatty acids.

2—A sufficiently high flash point to preclude danger in handling.

3—As low a tendency to gum as possible under exposure to the air. The matter of oxidation is important here, in that an oil which gums readily will oxidize more rapidly than, say, a non-gumming mineral oil, thereby increasing the danger of spontaneous combustion.

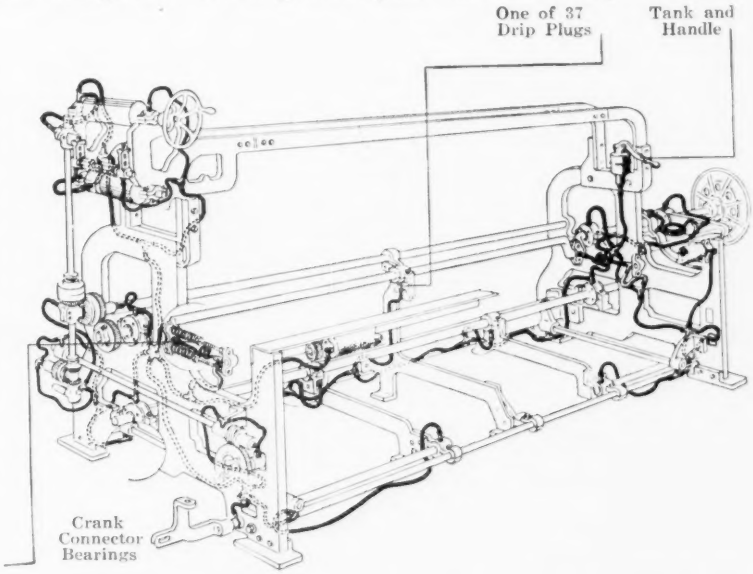
4—An ability to be readily washed from the goods. Oil stains due to such residues are the cause of subsequent difficulties in dyeing. Therefore the ideal wool oil should not stain the goods at all.

5—Free fatty acids such as oleic, for example, should be as low as possible, otherwise there may be danger of corrosion occurring on certain parts of the machinery such as the pins of the combs, or deterioration and rotting of the leather backings which form the card clothing. In other words, card clothing, which is kept relatively free from oil, will show a considerably longer life.

6—The viscosity or body of the oil should be sufficiently light to permit of proper penetration, yet heavy enough (commensurate with the wool under treatment) to insure that enough of it remains to give the proper results during opera-

tion. We should guard against too heavy or viscous an oil, however, inasmuch as its use may impose a considerable drag on the machine with the result that power consumption may be markedly increased.

7—It should be of a sufficiently non-drying nature to insure that stock which is to be oiled and then stored for any length of time will not become sticky, rancid or hard. The use of drying oils either alone or in compound, should therefore be guarded against. Both olive and lard oils, which are so much used, are socalled non-drying oils. For oiling wool preparatory to spinning, lard oil is preferred by some mills.

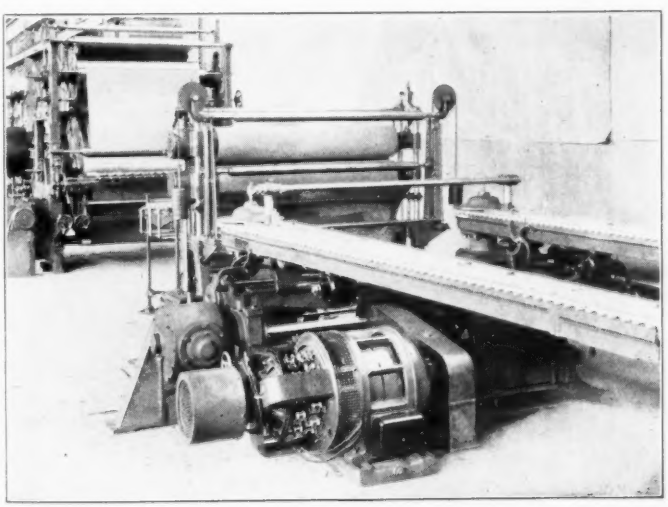


Courtesy of Crompton and Knowles Loom Works

Fig. 7—Line sketch of a loom showing piping elements with location of points of application pertinent to a system of centralized pressure oiling.

Available Products

The oils which either alone or in compound will in general give the most complete satisfaction according to the above requirements are olive, lard, rapeseed, peanut and certain other fixed oils. All these can be effectively compounded with mineral oils, thereby reducing the price per gallon considerably. There was a time when mineral oils were more or less avoided in the woolen and worsted industries, but the degree of success to which they can be compounded with certain of the above fixed oils to give complete and satisfactory emulsions which can ultimately be washed out, has been marked. Alone, however, mineral oils are not favored except in small quantities on stock which is to be stored for some length of time. Here the use of a straight mineral product will prevent the occurrence of rancidity, and under normal conditions is claimed to be capable of sufficient removal to prevent subsequent stains or dye-house difficulties. Were it only necessary for a wool oil to lubricate the fibres of the stock, a mineral oil would be one of the best products to use, but the matter of removal must always be taken into consideration, for this is as important as the former.



Courtesy of Morrison Machine Company

Fig. 6—Showing end of the tenter frame element of a sanforizing machine. In this device ball bearings have been found adaptable to certain parts, in the interest or improving lubrication and reducing power consumption.

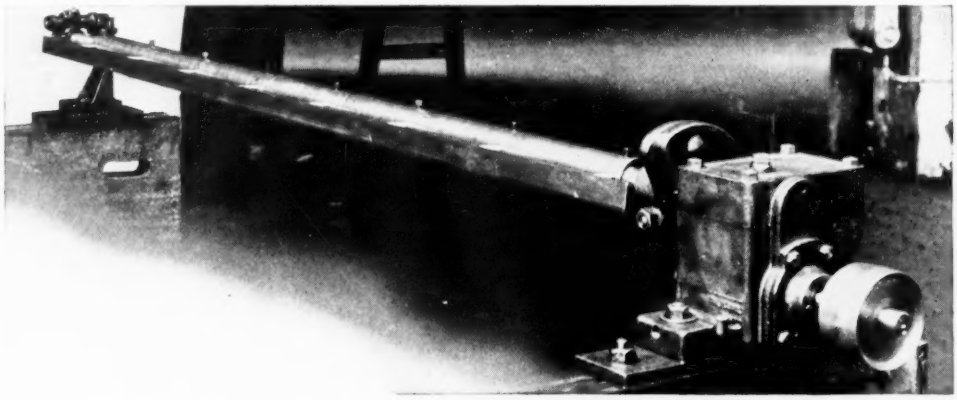
Free Fatty Acids

Opinion differs in regard to the amount of oleic or free fatty acid which a wool oil should contain. Certain authorities regard 6 percent as the maximum; others in turn are of the opinion that this can be exceeded, as for example, in the case of pure olive oil which may contain in the neighborhood of 20 per cent. Oleic acid is an excellent saponification medium and by virtue of its presence

in such non-drying oils as mentioned above, is capable of perhaps giving the best all-round service in wool or worsted reconditioning.

On the other hand, an excess of oleic acid will be a detriment for the reason that it not only

1. They are low in acid content.
2. They will not tend to gum or harden.
3. They do not oxidize readily, thereby reducing the dangers from spontaneous combustion, and,



Courtesy of Proctor and Schwartz, Incorporated

Fig. 8—Showing a ball bearing doffer comb box. Note manner of housing construction. This enables splash oiling of upper bearings.

may affect the wool fibres, but may also require an excess of alkali to remove it during the subsequent process of scouring. Strong alkalis will tend to rot the fibres, especially if washing is not absolutely complete.

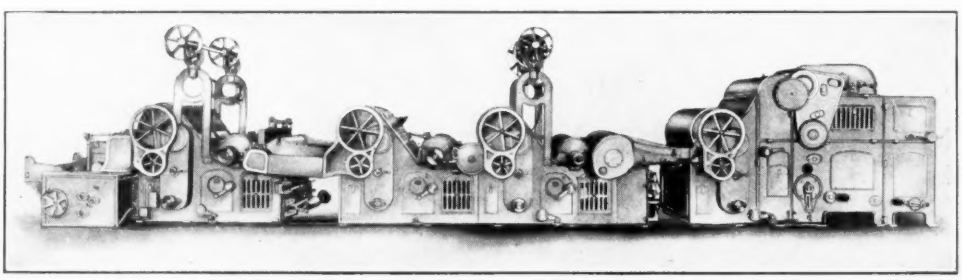
Advantages of Mineral Oil Compounds

This is certainly a point in favor of petroleum or mineral oil compounds. It is true, they may be somewhat more difficult to remove, especially if used to excess, due to the lesser extent to which they can be saponified, or emulsified with water. Also for this reason, there will be a somewhat greater possibility of oil stains occurring. On the other hand they serve the purpose effectively from the viewpoint of softening the fibres, providing a binder to keep these together, and lubricating them

4. They tend to cut or remove any natural wool oil which the stock may carry and which might prove injurious to card clothings.

But such products should be of a high degree of refinement, and compounded with the utmost care. In fact, it may be stated that the ease with which they can be scoured out or removed will be a measure of the care with which they have been prepared. It is quite possible that the science of petroleum refining will ultimately develop a pure mineral product capable of such ready emulsification, etc., which will serve the above purposes most satisfactorily.

In the use of such products the thoroughness with which the wool fibres are mixed with the oil is of decided importance. This process



Courtesy of H and B American Machine Company

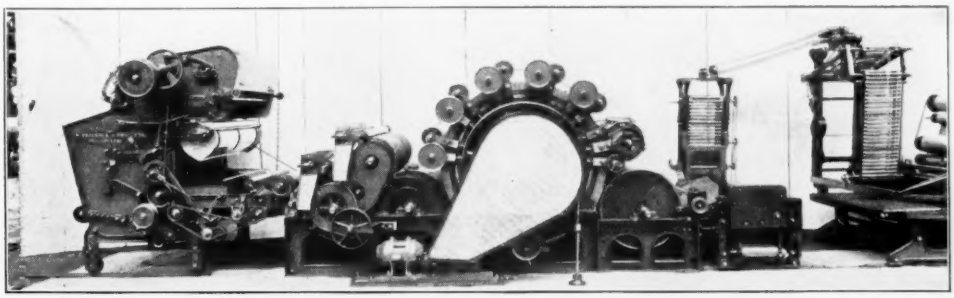
Fig. 9—Side view of a process picker. Note housing of operating mechanisms in the interest of protection of lubrication.

effectively during the processes of picking, combing and carding. Mineral oils or compounds in which these may be the major constituent possess certain other advantages which are most desirable, i.e.:

should always be very carefully carried out, otherwise streaking or uneven yarn may result. Heating of the oil or emulsifying it with water is claimed to be advantageous in this connection.

LUBRICATION OF KNITTING MACHINES

Lubrication plays an important part in the knitting mill, in view of the extent to which it may not only influence machinery operations and power economy, but also the effect which oil spots or stains may have upon the goods being handled.



Courtesy of Proctor and Schwartz, Incorporated

Fig. 10—View of a modern woolen card, motor driven through worm reduction. Application of ball bearings to this machine has been found adaptable in the interest of protection of lubrication and the product being handled.

Items such as (1) power losses, (2) machine friction losses, (3) oil stained fabrics, (4) replacement losses, (5) rate of production, and (6) repair expense, therefore markedly enter into the cost of production. In order to reduce losses, oil stains, and repair expense, etc., and keep production at a maximum, the purest grades of lubricants should be used at all times.

In general, knitting machinery, whatever its type or function, can be lubricated by four grades of lubricants:

(1) A compounded stainless knitting oil of about 100 seconds Saybolt viscosity at 100 degrees Fahr., for such mechanisms as are located in close proximity to the fabric, and from which oil drips might occur to damage the latter.

(2) A compounded pale oil of around 300 seconds viscosity for shaft bearings, etc., where the moisture content of the air may be abnormal.

(3) A straight mineral engine oil of from 180 to 300 seconds viscosity for shaft bearings, cam mechanisms, roll bearings, and electric motors throughout the mill; and

(4) A pure grade of light grease free from acid or alkali for anti-friction bearings, miscellaneous gears, and driving chains.

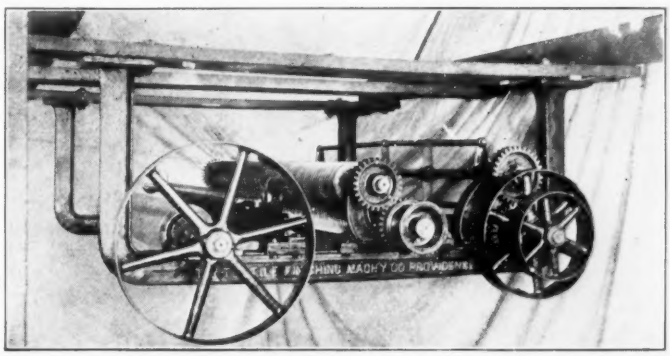
Warp and Full-fashioned Machines

Warp knitting machines of the Tricot, Milanese, and Raschel types will require careful lubrication of the needle, guide, sinker and presser mechanisms, etc. The same will apply to needles and sinkers of the full-fashioned machine.

The lubricant should be a high grade stainless knitting oil; it must be carefully and sparingly applied, to prevent access and possible damage to the fabric. The cams and other operating mechanisms, including bearing boxes, should also be lubricated with the same oil, similar care being exercised in its application. Such other operating parts as frame bearings, motors, driving gears, and chains are less apt to cause damage to the fabric through faulty lubrication; yet to insure economy and maximum production, their lubricants must also be carefully selected and applied.

Cleaning and Oiling of the Jacks

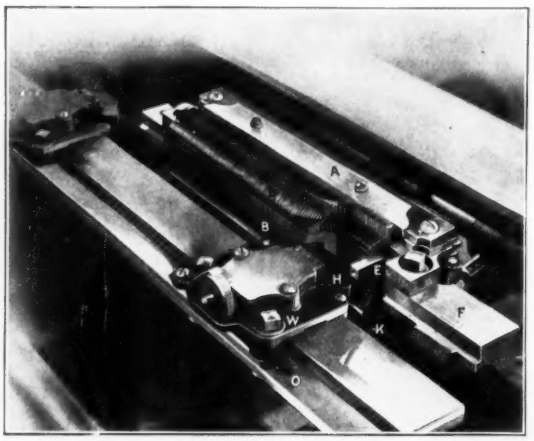
In the full fashioned knitting machine even movement of the jacks has a material effect upon the durability of the sinkers and verge plates. Should jack movement be at all delayed or uneven considerable trouble may result, especially in regard to broken sinkers. Even movement of the jacks can be assured by careful and regular cleaning and lubrication. If



Courtesy of The Textile-Finishing Machine Company

Fig. 11—Showing a Standard Ceiling type Scutcher. The scroll rolls and beaters of this machine are mounted in roller bearings.

such a program is not followed and gummy matter is developed by the oil, particularly when machines are idle for any length of time, it may lead to trouble.



Courtesy of Textile Machine Works

Fig. 12—Showing sinker head, jack bed and cock box on a full fashioned knitting machine. Constructional details necessitate the utmost care in lubrication, in order to protect the knitted fabric from oil spots.

Recommended practice by builders of such machinery is to clean jacks and sinkers with kerosene at least once each month. Re-lubrication, however, should be practiced at least every two weeks, using a highly refined oil which will show the least tendency to gum.

Circular Knitting Machines

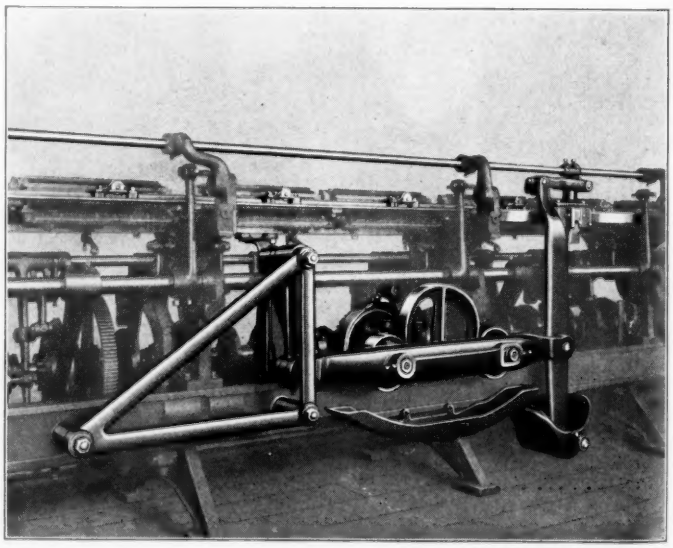
In circular or tubular knitting machines a point where careless selection and application of the lubricant may cause trouble is on the roll take-ups and worm gear attachments which serve to keep the fabric under uniform tension during knitting. For this service a pure stainless knitting oil should always be used in order not only to eliminate excessive loads upon the needles, but as well to prevent gumming. Were the oil to gum and become relatively stiff, the rollers would work sluggishly and abnormal wear would be apt to occur. It is therefore advisable to watch such mechanisms carefully, and even though the best grade of oil is used, to remove and rinse them in kerosene about once every month to insure that they are perfectly clean and free from gummed oil or accumulated dust and lint.

To prevent oil spots on the fabrics, needle cylinders and dials on certain of the circular knitting frames must also be oiled carefully. Self-feeding oil cups are sometimes installed on the machines for this purpose, but owing to their positive action, unless promptly turned off whenever the machine is stopped, they will tend to flood the working parts and cause serious oil spots or even streaks.

Application of Lubricants

Knitting machines may be lubricated either by the machine operators themselves or by a mechanic or fixer who has charge of entire plant lubrication. There are advantages and disadvantages pertinent to both methods, although the latter is perhaps the most satisfactory unless the individual operators are properly instructed as to the manner in which their machines should be lubricated. At all events, whoever has this duty to perform should fully understand the machines and their respective parts that require lubrication, and should appreciate the detrimental effects that careless, sloppy, or excessive oiling may have upon the knitted fabric. Knitting machines should be lubricated at regular intervals, the frequency to be based on their actual time of operation.

The essential point to remember in the lubrication of knitting machines is that the least amount of oil that will adequately lubricate the working parts is the best insurance against the occurrence of oil spots. If, in conjunction



Courtesy of Textile Machine Works

Fig. 13—Rear view of the Coulier motion of a full fashioned knitting machine. Lubrication is brought about by using oil-soaked felt in the pan below the motion. Careful lubrication of the Coulier cam is highly essential in preventing wear and insuring positive and uniform travel.

with such a policy, the best grade of stainless knitting oil is used wherever there is danger of dripping or splashing, the lubricating problems in the knitting mill should be practically eliminated.

DYE-HOUSE OPERATIONS

Textile materials after spinning or throwing may either be sent to the dye-house and colored preparatory to weaving, or they may go directly to the weaver. In the latter case the woven product is piece-dyed according to market demands much in the same manner as the skeins are treated. Both methods are extensively used.

In the production of certain grades of silks for piece-dyeing, oftentimes the warp or organzine is woven raw. Frequently such products are composed of a raw silk warp with a rayon filling, and two baths are necessary, i.e., one to color the raw silk, and a second to color the rayon. The puckery effect in certain crepe goods is obtained by the silk yarn having been so thrown that every two or more adjacent threads are of opposite twist. In the dyeing process the tendency of these threads to unwind gives the desired appearance to the goods.

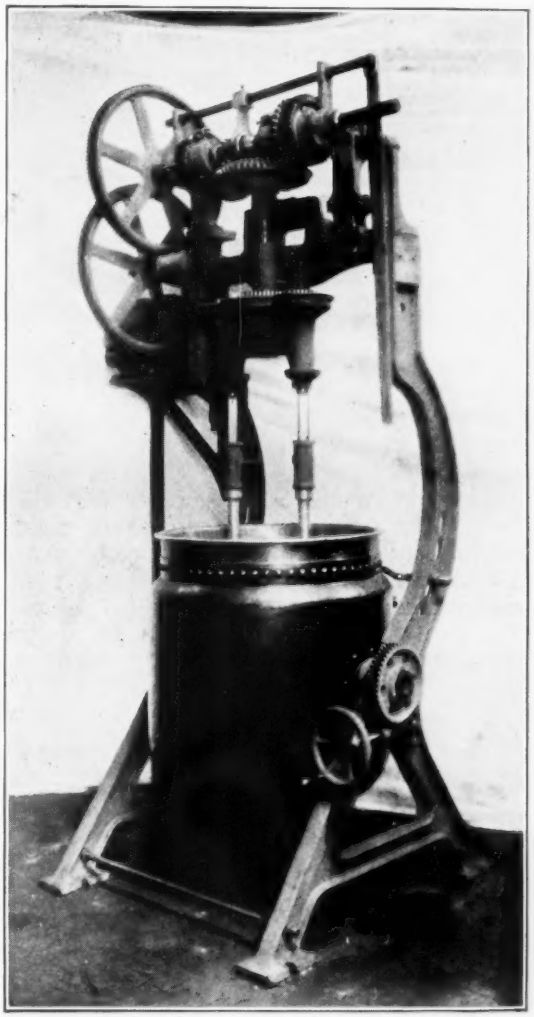
In the silk mill, the usual process is to dye in loosened skeins or bolts after they have been sufficiently boiled or de-gummed to extract any adhering gums and natural coloring matter they may contain, as well as soaking oils and soap. One, two, or three boilings may be necessary according to the nature of the silk and the percentage of impurities. If white silk is desired, three boilings are customary, followed by suitable bleaching. Then, in the case of skein dyeing, if the thread is to be "pure-dyed" it is passed immediately to the coloring tanks.

Frequently silk is loaded or weighed with such substances as tannins, or metallic salts to give special finishes. The process generally consists of treatment in suitable baths containing these substances, followed by a period of whizzing in a hydro-extractor, and then washing to remove free acids which would tend to rot the threads. The purest grade of water obtainable should be used in all of the dye-house treatments in order to insure the most perfect coloring and chemical reactions, and render the silk of the desired lustre.

Dye-House Machinery Lubrication

In studying the lubrication of dye-house machinery, in addition to the more usual mechanical problems of lubrication, one will also have to deal with certain possible chemical reactions. There is more or less of a direct tie-up between lubrication in the dye-house and lubrication in the power plant, particularly in connection with steam cylinders wherever condensed or exhaust steam may be used for heating purposes by passing it directly into open dye vats or heating tanks.

In order for the process of dyeing to be complete and satisfactory, it is essential that it be carried out with as pure water as possible; it is particularly important to prevent entry of oily matter for this has been found to lead to streaks and impair the "take" of the dye. By use of soft water, removal of oily matter will be expedited. This is a distinct essential where goods are being handled, which may at some prior stage have been treated with oils for the purpose of improving texture of the raw stock prior to spinning.



Courtesy of The Textile-Finishing Machinery Company

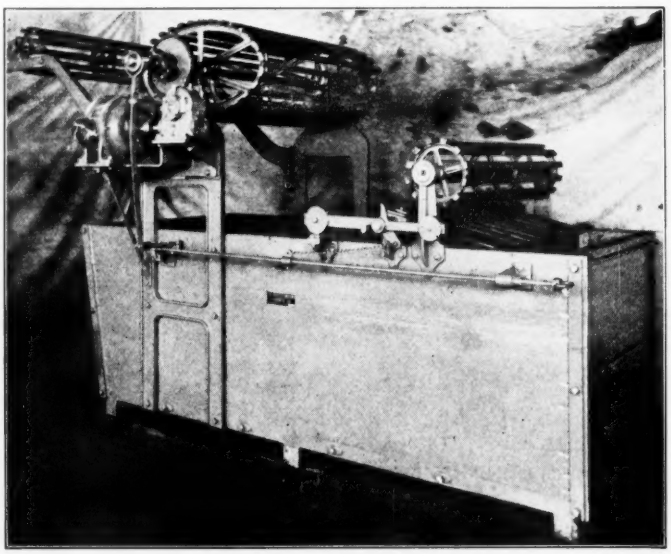
Fig. 14—Showing a color kettle arranged with a double stirring or agitating device. Although speed of the stirrers is comparatively low, careful lubrication of the overhead moving parts is essential, in the interest of preventing oil drip into the kettle.

It is perfectly practicable to remove cylinder oils from exhaust steam or condensate by use

of a suitable type of oil extractor or separator, and normally this is customary practice. On the other hand, from a mechanical point of view, the most positive protection is assured by using heating coils in the vats, thereby eliminating any possibility of contaminating dye liquors with detrimental components which might be carried over by the exhaust from the engines or pumps.

In order to insure a thorough understanding of the extent to which exhaust steam or condensate may be contaminated with a cylinder oil, it is well to study briefly certain of the details of steam cylinder lubrication. Products of this nature, as prepared for average steam conditions, are compounded with from 4 to 10 per cent of some fixed or animal oil, such as tallow, lard oil, or degras. The use of such compound is essential to the formation of a sufficiently adhesive lubricating film on cylinder walls or valve surfaces wherever steam may possess any appreciable moisture content, otherwise this latter, in form of actual water being increased by cylinder condensation, would tend to wash a straight mineral oil lubricating film off the cylinder walls.

In view of the fact that steam driven reciprocating pumps and frequently steam engines will be used in average dye-house or textile mill operations, steam cylinder oil is, therefore, a necessity. It must, however, be confined to its intended purpose and not allowed to gain entry where it might impair the dyeing operations or subsequent finish of the goods. It is also important to remember that steam cylinder oil, particularly where it might be used to an excess and subsequently returned to the boilers with make-up feed water, might give rise to foaming or priming in the boilers. This may oftentimes cause further difficulties, for where foaming or priming occurs a considerable volume of water may be carried over with the steam, should the water contain an appreciable amount of calcium or magnesium sulfates or carbonates. Further chemical reaction with fixed or animal oil compounds in the cylinder oil will cause formation of insoluble salts. These latter would also preclude effective cylinder lubrication in any reciprocating steam driven unit, by causing deposits which would prevent proper functioning of piston rings or cause valve leaks.



Courtesy of The Textile-Finishing Machinery Company

Fig. 15—Showing an oval reel type dyeing machine. Positive operation and retention of lubricant in the bearings of the reels is assured by using ball bearings.

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EDGAR C. RUWE CO., INC.
72 Washington St., N. Y. C.